A compendium of shipbuilding standards. Interim report on subtask I: regulatory body and classification body shipbuilding standards.

Corporate-Tech Planning, Inc.

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THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

TASK S-20

A COMPENDIUM OF SHIPBUILDING STANDARDS

U. S. DEPARTMENT OF COMMERCE

MARITIME ADMINISTRATION

in cooperation with

BATH IRON WORKS CORPORATION
700 Washington Street
Bath, Maine 04530

INTERIM REPORT
ON

SUBTASK I

REGULATORY BODY AND CLASSIFICATION BODY
SHIPBUILDING STANDARDS

prepared by:

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MAY 1979

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. The purpose of Task S-20 of the Ship Producibility Research Program is to review shipbuilding and other industrial standards for possible use in the National Shipbuilding Standard Program and to catalogue those standards that appear to have potential application within the program for ASTM F-25 Subcommittee action. This report covers results of Subtask I, the objective of which was to catalogue existing shipbuilding standards as promulgated by regulatory bodies and classification societies.

To allow users to identify individual subjects within the specifications which were examined, each single subject that might impact on the shipbuilder is coded separately. Thus there are 107 entries for ABS Rules for Building and Classing Steel Vessels. Each entry is a discrete subject and is treated as a separate standard.

2. The shipbuilding standards which predominate in U.S. shipbuilding are most commonly those promulgated by three organizations; the American Bureau of Shiping, the Maritime Administration, and the Coast Guard. In addition, eleven government organizations write standards that are imposed on the shipbuilding industry by direct application or by reference from another standard. Eighty percent of the standards are from the regulatory community, while only twenty percent come from the voluntary consensus standards organizations.

3. The standards deal for the most part with Auxiliary Systems (28%), Outfit and Furnishings (15%), General Guidance (13%), and Hull Structure (11%).

4. Ninety-one percent of the standards are in the format of a specification.

5. The heaviest concentration falls on F-25 Subcommittee 03, Outfitting, and on Subcommittee 10, Electrical and Electronics.

6. All standards are computer listed into four different types of groupings:

- Originating organization
- Navy Ship Work Breakdown Structure (SWBS)
- Subject
- Suggested F-25 subcommittee assignment

All 2596 standards were first sorted by ADP equipment in accordance with each of the above categories, then were individually analyzed. Copies of these listings have already been distributed for your use.

7. The results of Research Task S-20, A Compendium of Shipbuilding Standards, will be published as three subtask reports plus a final report as shown in the following box. Information from special research conducted to assist certain F-25 subcommittees will be included in the final report.

REPORT	SUBJECT	PLANNED PUB. DATE
Subtask I	U.S. Shipbuilding Standards and Regulations	August 1979
Subtask II	U.S. Industrial Standards for Shipbuilding	August 1979
Subtask III	Foreign Shipbuilding Standards	March 1979
Final	Summary and Conclusion from all Subtasks and Special Research	September '79

EDITOR'S NOTE

This is a report of Subtask I only. A report will be issued on Subtask II very soon. The Final Report will be issued in September combining and comparing the findings of Subtasks I, II, and III. Some updating of this report may take place before it is incorporated into the final report. The F-25 subcommittee assignments are preliminary pending Executive Subcommittee of ASTM Committee F-25 on Shipbuilding approval. The computer runs were made directly from key entry data without any error search. SWBS categories are on a best fit basis. Anyone wishing to have errata corrected should contact Mr. James A. Burbank, II, at Corporate-Tech Planning Inc., John Hart Mansion - The Hill, Portsmouth, New Hampshire 03801 or telephone 603-431-5740.

As an editorial convention, "MarAd" has been used when the Maritime Administration of the Department of Commerce is intended. "MARAD" has been used when referring to the standards published by the Maritime Administration.

1.1 PURPOSE

The purpose of Subtask I is to review and catalogue the standards most frequently used by the shipbuilding industry. When several typical shipbuilding contracts were examined, it was obvious that the major sources of standards used in shipbuilding are the classification societies and the regulatory bodies. As a result, Subtask I covers the requirements of these two groups of standards writing organizations.

The rules and regulations generally deal with many subjects in one volume. To make a listing of these requirements that would be useful to the shipbuilder and to permit the F-25 subcommittees to make comparisons, each discrete subject was listed separately and given its own identification number. The identifying number provides an audit trail back to the original document via a section and subsection identifier.

1.2 SCOPE

The largest impact on U.S. shipbuilders comes from requirements on standards issued by the following:

- United States Coast Guard
- American Bureau of Shipping
- Maritime Administration

The above three organizations make reference to another tier of standards which are included in this catalogue. The majority of these second tier standards are published by:

- American Society for Testing and Materials
- American National Standards Institute
- Institute of Electrical and Electronics Engineers
- Joint Industrial Council
- National Electrical Manufacturers Association
- Underwriters' Laboratories, Incorporated

Military Specifications and Federal Specifications are also used extensively and are included in this subtask.

This catalogue lists 2596 individual citations. These have been extracted from 712 documents, such as the Code of Federal Regulations. Table 1-1 summarizes the distribution of standards by originating organization and the percentage that number represents of the total.

CLASSIFICATION/REGULATORY			INDUSTRIAL		
	NUMBER	%		NUMBER	%
ABS	674	26.0	ABYCP	1	
DOD	2	--	AMCA	2	--
DOL	4	--	ANSI	123	4.7
EPA	4	--	ASTM	100	3.9
FED	136	5.2	FCI	1	--
IMCO	1	--	HEI	7	--
MARAD	910	35.1	HI	1	--
MIL	60	2.3	IEEE	123	4.7
NBS	1	--	IES	1	--
PCC	3	--	IPCEA	1	--
SCA	1	--	JIC	43	1.7
SOLAS	1	--	MSS	17	0.7
USCG	266	10.2	NEMA	34	1.6
USDA	3	--	NFPA	3	--
USN	2	--	OCIMF	2	--
USPHS	1	--	SNAME	9	--
			SSPC	1	--
			TEMA	1	--
			UL	57	2.2
SUBTOTAL	2069	79.7*		527	20.3*
TOTAL				2596	100%

* Totals may be imprecise because individual figures have been rounded in this and other tables.

TABLE 1-1: NUMBER OF STANDARDS CATALOGUED IN SUBTASK I BY ORIGINATING ORGANIZATION.

Table 1-2 lists the number of documents which were examined for each organization. For example, the ABS Rules for Building and Classing Steel Vessels is one document and the ABS Rules for Building and Classing Offshore Mobile Drilling Units is another document. The method of selection as described involved examining those documents which were cited in contracts. All of the documents issued by one organization were not examined. For example, only parts 40 and 41 of the Code of Federal Regulations were included for the EPA. Other EPA documents do not have the immediate applicability to the ship itself, although there are many other EPA requirements imposed on shipbuilders and on the tier of manufacturers who support shipbuilders.

	DOCUMENTS		
ABS	20	MASS	1
ABYCP	1	MASSD	1
AMCA	2	MIL	60
ANSI (ANS)	122	MSS	17
ASTM	100	NBS	1
DOD	2	NEMA	34
DOL	1 (CFR PART 29)	NFPA	3
EPA	2 (CFR PART 40 & 41)	OCIMF	2
FCI	1	PCC	1 (CFR 35)
FED	136	SCA	1
HEI	7	SNAME	9
HI	1	SOLAS	1
IEEE	48	TEMA	1
IES	1	UL	57
IMCO	1	USCG	3 (CFR 12)
IPCA	1	USDA	3
JIC	2	USN	1
MARAD	67	USPHS	1

NUMBER OF DOCUMENTS	712
NUMBER OF ORGANIZATIONS	34

TABLE 1-2: NUMBER OF DOCUMENTS EXAMINED FOR EACH OF THE ORGANIZATIONS.

1.3 METHOD

The same data methods of analysis were used as for Subtask III. See pages 2 through 5 of that report. The computer runs for this subtask have already been distributed by the MarAd Research Program Manager at Bath Iron Works, Mr. John C. Mason.

1.4 ACRONYMS

Organizations which issue standards have been identified by a code of two to five letters in the text of this report and in the computer print-out. Appendix A contains the list of the full names of the organizations.

2.1 ANALYSIS OF FINDINGS

2.1.1 Originating Standards Organizations

As seen in Table 1-1 on page 2, 80% of the standards were originated by regulatory bodies or by classification societies. Of the approximately 2000 such standards, MARAD accounted for 44%, ABS for 33% and the Coast Guard for 13%. The remaining 10% were distributed among 13 other groups, such as the Department of Defense (DOD), U.S. Public Health Service (USPHS), Federal Specifications (FED) and Military Specifications (MIL). See Table 2-1.

ORIGINATING ORGANIZATION		CATALOGUED STANDARDS	
		NUMBER	%
MARITIME ADMINISTRATION	MARAD	910	44
AMERICAN BUREAU OF SHIPPING	ABS	674	33
U. S. COAST GUARD	USCG	266	13
OTHERS		219	10
TOTAL		2069	100%

Table 2-1: DISTRIBUTION OF STANDARDS BY ORIGINATING ORGANIZATION WITHIN THE CLASSIFICATION/REGULATORY GROUP.

Twenty percent of the primary standards were published by industrial standards groups. Of these approximately 500 standards, ASNI, IEEE, and ASTM published 66%.as noted in Table 2-2.

ORIGINATING ORGANIZATIONS		CATALOGUED STANDARDS	
		NUMBER	%
AMERICAN NATIONAL STANDARDS INSTITUTE	ANSI	123	23
INSTITUTE OF ELECTRICAL & ELECTRONIC ENGINEERS	IEEE	123	23
AMERICAN SOCIETY FOR TESTING AND MATERIALS	ASTM	100	20
OTHERS		181	34
TOTAL		527	100%

TABLE 2-2: DISTRIBUTION OF STANDARDS BY ORIGINATING INDUSTRIAL STANDARDS ORGANIZATION.

Some caution is necessary when comparing results of Subtask III on Foreign Standards with the results of Subtask I, Regulatory Agency and Classification Society Standards. Because the method used to select the standards differed between the two subtasks, the foreign standards listings do not contain examples of regulatory body standards. This is illustrated in Figure 1 on the next page.

In examining U.S. shipbuilding standards, what surprised the investigators was the predominance of non-industrial standards. IEEE, ANSI, and ASTM accounted for only 14% of the standards found in use in U.S. shipbuilding.

2.1.2 Type of Standard

The distribution of domestic and foreign standards by type is summarized in Table 2-3 on page 7. The classification by type into one of five groups is based on the most likely use of the standard by shipbuilders. This is an important consideration because the type of standard should be determined by the intended use. It was found that a significant number of standards were not

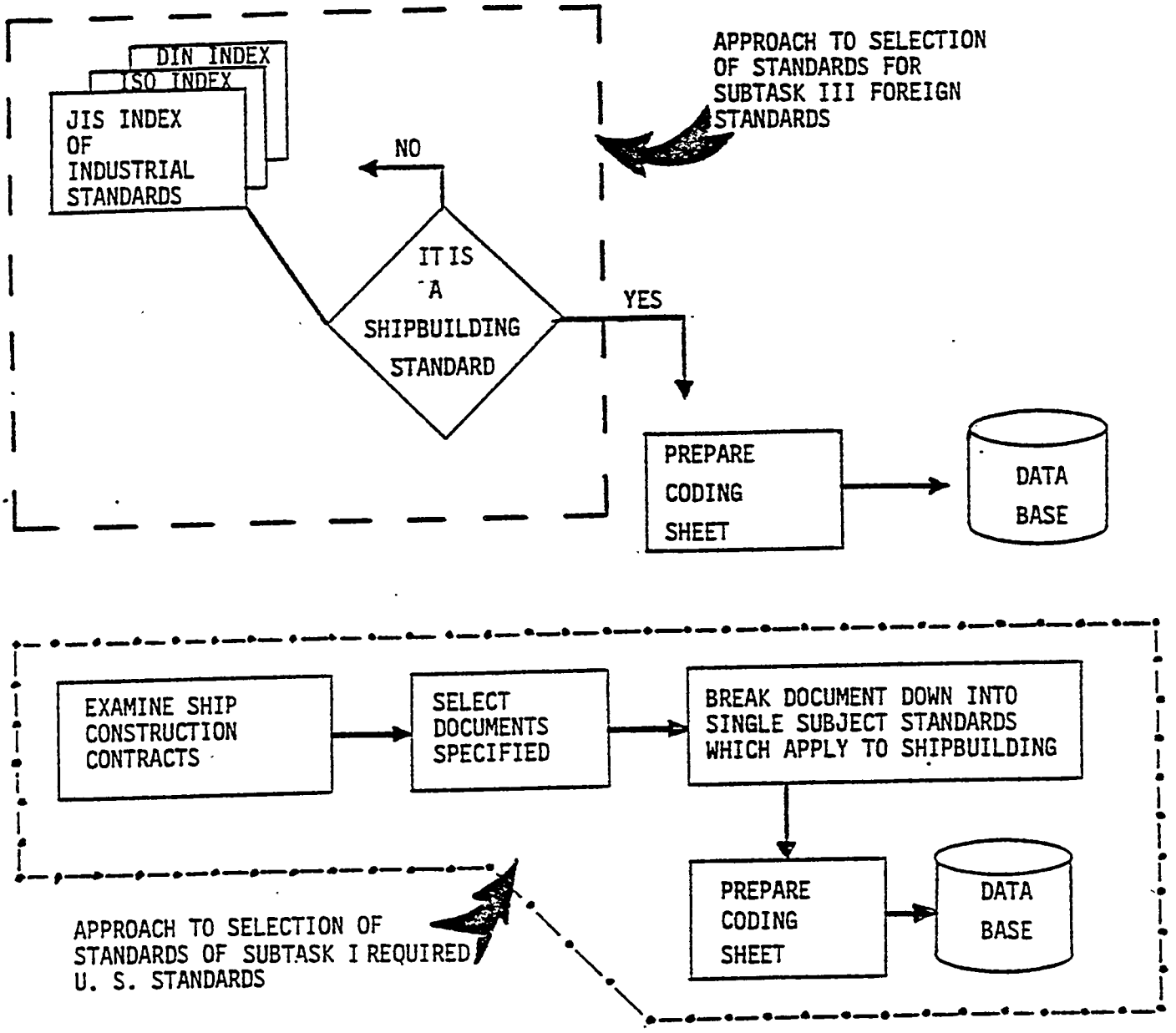

FIGURE 1: COMPARISON OF METHOD USED TO SELECT STANDARDS FOR SUBTASK III AND SUBTASK I.

TYPE OF STANDARDS BASED ON INTENDED USE	SUB TASK I	SUB TASK II	SUB TASK III
	U.S.	U.S.	FOREIGN
1 DEFINITION AND CLASSIFICATION	1.8%	4.3%	4%
2 DESIGN	2.3	1.1	5
3 PRODUCTION AND OPERATION	0.2	3.6	1
4 TEST	4.8	48.4	2
5 SPECIFICATION	90.8	42.8	88
	100%	100%	100%

TABLE 2-3: DISTRIBUTION OF TYPES OF U.S. AND FOREIGN STANDARDS FROM ALL THREE SUBTASKS.

of the best type for the intended use. Although both the U.S. and the foreign results show some 90% of the standards classified as "specifications", the foreign shipbuilding standards are better suited for their intended use than U.S. standards. The foreign standards were written by groups of people who were going to utilize them. The purpose of the standard usually was known. The role of the standard in the system of standards was also predetermined. As a consequence, foreign standards are easier to use. They do not require as many cross-references as U.S. shipbuilding standards do. The foreign standard intended to specify a windlass or a winch will give enough information to allow several vendors to supply a standard winch without requiring the shipyard to redesign foundations or service connections.

Tables 2-4 and 2-5 show the distribution within Subtask I of standards by type for the regulatory and the industrial group.

TYPE OF STANDARD BASED ON INTENDED USE	SOURCE OF STANDARDS		
	REGULA-TORY	INDUS-TRIAL	TOTAL
1 DEFINITION AND CLASSIFICATION	22	25	47
2 DESIGN	15	46	61
3 PRODUCTION AND OPERATION	2	5	6
4 TEST	63	62	125
5 SPECIFICATION	1967	390	2357
TOTAL	2069	527	2596

TABLE 2-4: NUMERICAL DISTRIBUTION OF STANDARDS IN SUBTASK I BY TYPE.

TYPE OF STANDARD BASED ON INTENDED USE	SOURCE		
	REGULA-TORY	INDUS-TRIAL	TOTAL
1 DEFINITION AND CLASSIFICATION	0.8%	1.0%	1.8%
2 DESIGN	0.6	1.8	2.3
3 PRODUCTION AND OPERATIONS	0.1	0.2	0.2
4 TEST	2.4	2.4	4.8
5 SPECIFICATION	75.8	15.0	90.8
SUBTOTAL	79.7	21.3	100.0
TOTAL	100%		

TABLE 2-5: PERCENTAGE DISTRIBUTION OF STANDARDS IN SUBTASK I BY TYPE.

2.1.3 Units of Measure

The majority (64.7%) of the standards reviewed were in U.S. Customary units of measure. An additional 28.7% were dual dimensioned in both U.S. Customary and S.I. Units. Metric units only were on 1.7% of the standards (mostly ABS Rules). The largest contributor to dual dimensioning was ABS, which accounted for 93% of the dual dimensional standards. Most shipbuilding standards have not been revised since dual dimensioning was adopted by ASTM, ASNI and other voluntary consensus standards organizations.

Table 2-6 summarizes the findings on units of measure for Subtask I.

SYSTEM OF UNITS		REGULA-TORY	INDUS-TRIAL	TOTAL
CODE	MEANING			
M	METRIC OR SI	1.5%	0.2%	1.7%
E	U.S. CUSTOMARY	48.3	16.4	64.7
N	NOT APPLICABLE	0.3	2.8	3.1
U	UNKNOWN	0.3	1.2	1.5
O	OTHER	0.0	0.3	0.3
D	DUAL	27.4	1.3	28.7
	TOTAL	77.8%	22.2%	100.0%

TABLE 2-6: UNITS OF MEASUREMENT USED IN DOMESTIC SHIPBUILDING STANDARDS

2.1.4 Potential Value to U.S. Shipbuilding Industry

Almost all of the standards offer potential benefits to the U.S. shipbuilders. On the other hand, 20% of the standards were identified as less beneficial to the shipbuilder for one of the following reasons:

- The standard does not apply directly to the work done by the shipyard but gives guidance to a lower tier supplier. Often these standards are needed to design or construct some equipment but do not affect any interface with the shipbuilding process.

- The standard is outmoded, such as DOD paint formula numbers 20L and 117.

- The standard applies to trivial items, such as a card table (MarAd Specification) or a blacksmith's anvil or a wooden rolling pin (Federal Specification).

However, the problems with individual standards were minor compared to the problem generated for the shipyards because there are so many standards (two or three times as many as European and Japanese standards organizations feel are needed for their shipbuilding needs) and because the standards are not in an integrated, self-consistent and non-redundant system.

It is also important to note that the individual standards are not systematically related into a meaningful whole family of standards. That problem must be addressed. Voids or holes exist in the coverage, and voluntary consensus standards are needed to fill these holes.

2.1.5 Age of Standards

In recent years, some standards organizations have developed a system for the review of standards in three, four, or five year cycles. This is done to ensure that the standard is still needed and is current on technical matters. The cyclical review system has not yet updated all shipbuilding standards as Table 2-7 indicates on the next page.

PERCENT OF STANDARDS	7.5	15.6	15.3	8.0	3.9	7.8	21.3	9.4	0.5	10.7	100%
YEARS	1	2	3	4	5	6	7	8	9	10 & OVER	TOTAL

TABLE 2-7: NUMBER OF YEARS SINCE LAST ISSUE OR REAFFIRMATION OF STANDARDS

Although a standard is not obsolete just because of its age, a systematic review of the older standards should identify those which have become obsolete for technological reasons or for lack of use.

2.1.6 Changes Required for Use of Standards in U.S. Shipbuilding

All the standards except domestic nuclear standards were classified as being useful without modification basically because they were all being used to some degree. However, it is important to point out that many standards could be eliminated, a fact that cannot be recognized when reading an individual standard for the purpose of filling out a coding sheet. Other standards need to be purified so that they meet the needs for which they are intended. Design standards should be limited to design criteria only and should not contain manufacturing instructions or purchasing terms.

2.2 ANALYSIS BY SWBS GROUP

All of the standards were given an identifying number based on the U.S. Navy's Ship Work Breakdown Structure (SWBS). Under the SWBS system, the work of building a ship is classified into ten basic groups based upon the ship system in which the part is located. Some of the standards examined in Subtask I apply to parts which are common to several systems. The assignment of an SWBS number to such standards was based upon where, in the best judgment of the analyst, a marine engineer could be expected to look for the item.

The ten major SWBS work groups are: (Source: NAVSEA 0900-LP-039-9010)

GROUP NAME	IDENTIFYING NUMBER
General Guidance and Administration	000-099
Hull Structure	100-199
Propulsion Plant	200-299
Electric Plant	300-399
Command and Surveillance	400-499
Auxiliary Systems	500-599
Outfit and Furnishings	600-699
Armament	700-799
Integration/Engineering	800-899
Ship Assembly and Support Services	900-999

Table 2-8 on the next page summarizes the distribution of standards by SWBS group for domestic and foreign standards. The most significant difference between the domestic standards studied in this subtask and the foreign standards of Subtask III is a heavier concentration of foreign standards in the area of auxiliary systems (500-599). The next large difference is in the area of General Guidance and Administration where 9% greater interest was demonstrated by domestic standards than by foreign standards. Domestic standards were again 9% more predominant in the Propulsion Plant group and by 5% in the related Electrical Plant group. Much of this difference may be explained by the different method used to select standards as mentioned in Section 2.1.1. This data is summarized in Figure 2 as a bar graph on page 14.

2.2.1 SWBS Group and Subgroupings

The General Requirements Group (000-099) has 344 standards identified with it. This represents 13% of the standards in Subtask I. Table 2-9 on page 15 shows the distribution by subgroup of these standards.

SWBS NUMBER	SWBS TITLE	SUBTASK 111 FOREIGN		SUB TASK I DOMESTIC	
		No.	%	NO.	%
000-099	GENERAL GUIDANCE AND ADMINISTRATION	15	4	344	13
100-199	NULL STRUCTURE	60	13	284	11
200-299	PROPULS1ON PLANT	18	4	348	13
300-399	ELECTRICAL PLANT	37	8	350	13
400-499	COMMAND AND SURVEILLANCE	29	7	123	5
500-599	AUXILIARY SYSTEMS	220	49	719	28
600-699	OUTFIT AND FURNISIIINGS	62	14	383	15
700-799	ARMAMENT	o	0	11	0
800-899	INTEGRATION/ENGINEERING	o	0	19	1
900-999	SHIP ASSEMBLY AND SUPPORT SERVICES	5	1	9	0
F	LOADS AND CONSUMABLES			6	0
	TOTAL	446	100	2596	100

TABLE 2-8: COMPARISON OF FOREIGN AND DOMESTIC STANDARDS BY SWBS DISTRIBUTION

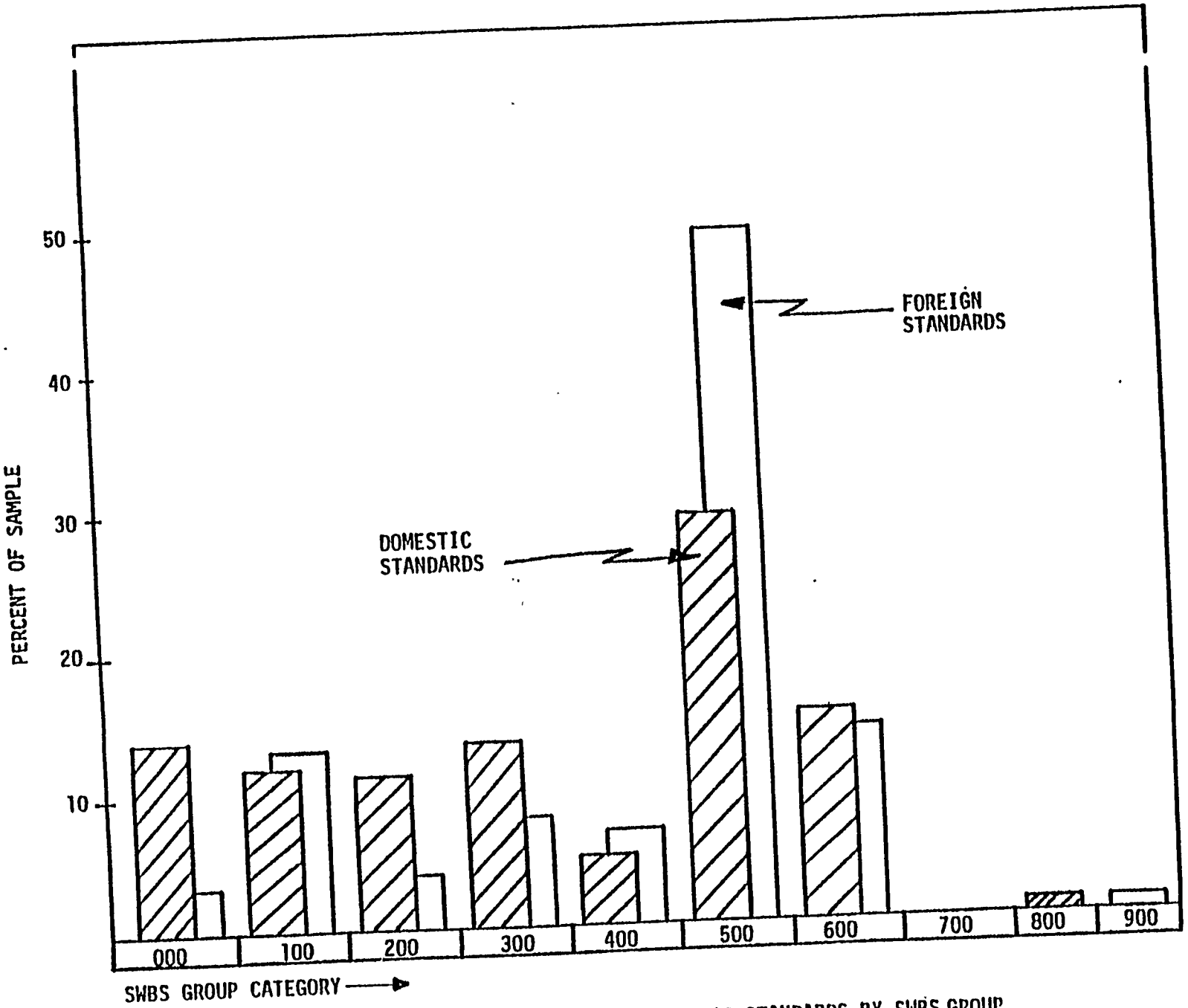

FIGURE 2: DISTRIBUTION OF FOREIGN AND DOMESTIC STANDARDS BY SWBS GROUP

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
042	General Administrative Requirements	63	18.3%
062	Propulsion Plant	1	0.3
070	General Requirements for Design and Construction	53	15.4
071	Access	5	1.5
072	Shock	1	0.3
073	Noise and Vibration	13	3.8
074	Casting, Welding, Riveting, Allied Processes (General)	66	19.2
075	Threaded Fasteners Standards	16	4.7
076	Reliability and Maintainability	2	0.6
077	Safety	6	1.7
078	Materials	44	12.8
079	Seaworthiness	1	0.3
080	Integrated Logistic Support Rqmts.	1	0.3
083	Supply Support	7	2.0
085	Engineering Drawings	27	7.8
086	Technical Manuals and Other Data	10	2.9
091	Ship Inspections	4	1.2
092	Ship Tests	5	1.5
094	Regular Ship Trials	1	0.3
095	Whole Ship Testing	13	3.8
096	Weight Control	1	0.3
097	Inclining Experiment and Trim Dive	2	0.6
098	Models and Mockups	2	0.6
	TOTAL	344	100.0

TABLE 2-9: DISTRIBUTION OF STANDARDS IN SWBS GROUP 000-999 GENERAL GUIDANCE AND ADMINISTRATION

General Administrative Requirements (042) amounts to 18.3% of the subgroup. About half of these standards came from the ABS Rules for Building and Classing Steel Vessels, Barges, Aluminum Vessels, and Dry Docks. One-third are ANSI drawing standards, and most of the rest are divided between MarAd and the Coast Guard.

General Requirements for Design and Construction (070) accounts for 15.4% of the subgroup. As might be expected, the various ABS Rules for Building and Classing dominate this subgroup, amounting to 83% of the citations within the 070 subgroup. In total, there are 53 entries in this subgroup. The standards cited are general guidance for design and construction and make this subgroup the most useful of all. A detailed review of all the standards needs to be made to see if there are any redundancies which can be eliminated. This subgroup has the potential of being helpful to the designers and builders of vessels.

The largest single subgroup was 074 Casting, Welding, Riveting, and Allied Processes with 19.2% of the citations. Almost half of these standards came from ABS rules, a quarter of the standards were ASTM material standards, and the other 25% were predominantly Coast Guard requirements for piping and pressure vessels.

The 079 Material category with 12.8% of the standards is one-half ASTM standards which were invoked by the regulatory group (ABS, USCG, MARAD) and which deal with material specifications or with material testing. The other half is comprised of Federal, Military and Coast Guard regulations for various materials from balsa wood to plastics.

The Hull Structure Group (100-199) has 285 standards listed, or 11% of the total in the Subtask I survey. Subgroup 100, Hull Structure General, is the largest with 24.3% of the group standards. Subgroup 116, Longitudinal Framing for Surface Ships and Submarine Pressure Hulls, is second at 12.7%. Subgroup 130, Hull Decks, is third with 12%. This is all the result of the ABS rules which dominate these subgroups. This group is summarized in Table 2-10 on the next page.

The Propulsion Plant Group (200-299) has 13% of the total standards, thereby ranking fourth among the groups. Within this group, 28 subgroups are represented with the distribution quite scattered. Subgroup 200, Propulsion Plant, General, has 18.1% of the citations within this group. MarAd wrote 44 of these 63 citations. The next smaller subgroup is 221, Propulsion Boilers, at 16.7% of the group. The Coast Guard provided 25, ASTM 16, and MarAd 12 of the 58 standards in Subgroup 221. Subgroup 225, Feed and Condensate Systems, includes 32 standards, or 9.2% of the group, the majority coming from MarAd. This group is summarized in Table 2-11 on page 19.

The Electric Plant Group (300-399) provides identification for 350 standards, 13.5% of the total. Ninety-three, or 16.6%, fell into the Electric Plant, General, Subgroup 300. The major contributors are shown in Table 2-12 below.

CONTRIBUTOR	NO. OF STDS.
JIC	21
IEEE	17
ABS	12
USCG	12
UL	11
MARAD	10
NEMA	5
TOTAL	88

TABLE 2-12: ORGANIZATIONS WHICH WROTE STANDARDS FOR SWBS SUBGROUP 300, ELECTRIC PLANT, GENERAL.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
100	Hull Structure, General	69	24.3%
110	Shell and Supporting Structure	1	0.4
111	Shell Plating	13	4.6
113	Inner Bottom	10	3.5
114	Shell Appendages	1	0.4
115	Stanchions	6	2.1
116	Longitudinal Framing	36	12.7
117	Transverse Framing	13	4.6
120	Hull Structural Bulkheads	24	8.5
121	Longitudinal Structural Bulkheads	4	1.4
122	Transverse Structural Bulkheads	2	0.7
123	Trunks and Enclosures	15	5.3
130	Hull Decks	34	12.0
140	Hull Platforms and Flats	1	0.4
150	Deck House Structure	17	6.0
160	Special Structures	1	0.4
161	Structural Castings, Forgings, and Equivalent Weldments	7	2.5
163	Sea Chests	4	1.4
167	Hull Structural Closures	9	3.2
168	Deck House Structural Closures	1	0.4
169	Special Purpose Closures and Structures	7	2.5
170	Masts, Kingposts, and Service Platforms	3	1.1
182	Propulsion Plant Foundations	2	0.7
191	Ballast, Fixed or Fluid, and Buoyancy Units	1	0.4
199	Hull Repair Parts and Special Tools	3	1.1
	TOTAL	284	100.0

TABLE 2-10: DISTRIBUTION OF STANDARDS IN SWBS GROUP 100-199, HULL STRUCTURE

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
200	Propulsion Plant, General	63	18.1
202	Machinery Plant, General Control Systems	14	4.0
210	Energy Generating System (Nuclear)	3	0.9
221	Propulsion Boilers	58	16.7
231	Propulsion Steam Turbines	14	4.0
233	Propulsion Internal Combustion Engines	12	3.4
234	Propulsion Gas Turbines	1	0.3
235	Electric Propulsion	16	4.6
240	Transmission and Propulsor Systems	1	0.3
241	Propulsion Reduction Gears	8	2.3
242	Propulsion Clutches and Couplings	16	4.6
243	Propulsion Shafting	23	6.6
244	Propulsion Shaft Bearings	14	4.0
245	Propulsors	9	2.6
250	Propulsion Support Systems (Except Fuel & Lube Oil)	2	0.6
251	Combustion Air System	6	1.7
252	Propulsion Control System	12	3.4
253	Main Steam Piping System	2	0.6
254	Condensers and Air Ejectors	5	1.4
255	Feed and Condensate System	32	9.2
256	Circulating and Cooling Sea Water Sys.	6	1.7
258	H.P. Steam Drain System	1	0.3
259	Uptakes (Inner Casing)	6	1.7
260	Propulsion Support System (Fuel and Lube Oil)	15	4.3
261	Fuel Service System	3	0.9
262	Main Propulsion Lube Oil System	3	0.9
264	Lube Oil Fill, Transfer and Purfication	1	0.3
299	Propulsion Plant Repair Parts and Special Tools	2	0.6
	TOTAL	348	100.0

Table 2-11: DISTRIBUTION OF STANDARDS IN SWBS GROUP 200-299, PROPULSION PLANT

The standards deal with definitions or testing of parts (components) which can be used on any of several systems. Switches, enclosures, conduits, wire, plugs and fittings are among the components covered.

Subgroup 304, Electric Cables, has 14.5% of the group standards from ABS, ASTM, IEEE, JIC, MARAD, MIL, NEMA, UL, USCG, and Navy documents. The subjects include the regulations on cable installation, description of wires and cable, installation of cables and electrical equipment, cable sizing, and a cable comparison guide. There is a good chance of duplication and overlap within this subgroup.

Subgroup 302, Motors and Associated Equipment, includes 38 standards, or 11.7% of the group. These standards draw heavily from IEEE and MarAd documents. The subjects covered are motors and controllers, their installation, protection and testing.

Subgroup 303 on Protective Devices has 11.4% of the standards. UL and NEMA standards on fuses and circuit breakers are the biggest single subject. ABS has six standards on requirements for protection devices; IEEE and JIC standards deal with protective devices for equipment. The Coast Guard requirements for overcurrent protection are in this subgroup. Table 2-13 on the next page shows the distribution of Electric Plant standards.

The Command Surveillance Group (400-499) has 122 standards, or 5% of the total. About 14% of these are in Subgroup 430, Interior Communications; another 11.5% are in Subgroup 436, Alarms, Safety and Warning Systems; Visual and Audible Systems (443) has 8.2%. The standards in these groups have been issued by ABS, IEEE, MARAD, NEMA, and USCG. See Table 2-14 on page 22 for the complete listings.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
300	Electric Plant, General	93	26.6
302	Motors & Associated Equipment	38	10.9
303	Protective Devices	37	10.6
304	Electric Cables	47	13.4
305	Electrical Designating and Marking	3	0.9
311	Ship Service Power Generation	10	2.9
312	Emergency Generators	21	6.0
313	Batteries and Service Facilities	12	3.4
314	Power Conversion Equipment	13	3.7
320	Power Distribution Systems	14	4.0
321	Ship Service Power Cable	4	1.1
324	Switchgear and Panels	25	7.1
330	Lighting System	8	2.3
331	Lighting Distribution	8	2.3
332	Lighting Fixtures	12	3.4
390	Special Purpose System	1	0.3
399	Electric Plant Repair Parts and Special Tools	4	1.1
	TOTAL	350	100.0%

TABLE 2-13: DISTRIBUTION OF STANDARDS IN SWBS GROUP 300-399, ELECTRIC PLANT

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
400	Command and Surveillance, General	3	2.4%
403	Personnel Safety	1	0.8
406	Grounding and Bonding	2	1.6
407	Electromagnetic Interference Reduction (EMI)	1	0.8
410	Command and Control Systems	3	2.4
420	Navigation Systems	3	2.4
421	Non-Electrical/Electronic Navigation Aids	7	5.7
422	Electrical Navigation Aids (incl. Navigation Lights)	7	5.7
423	Electronic Navigation Systems, Radio	6	4.9
424	Electronic Navigation Systems, Acoustical	3	2.4
426	Electrical Navigation Systems	6	4.9
430	Interior Communications	17	13.8
431	Switchboards for I.C. Systems	1	0.8
432	Telephone Systems	2	1.6
433	Announcing Systems	1	0.8
434	Entertainment and Training Systems	1	0.8
435	Voice Tubes and Message Passing Systems	2	1.6
436	Alarm, Safety and Warning Systems	14	11.4
437	Indicating, Order and Metering Systems	9	7.3
438	Integrated Control Systems	2	1.6
441	Radio Systems	9	7.3
443	Visual and Audible Systems	10	8.1
445	TTY and Facsimile Systems	2	1.6
451	Surface Search Radar	2	1.6
499	Command and Surveillance Repair Parts and Special Tools	9	7.3
	TOTAL	123	100.0%

TABLE 2-14: DISTRIBUTION OF STANDARDS IN SWBS GROUP 400-499, COMMAND AND SURVEILLANCE

The Auxiliary Systems Group (500-599) is the largest group, with 719 standards, or 28% of the total. This group was also the largest portion (49%) of the foreign standards examined in Subtask III. Standards are applied to 57 of the SWBS subgroups and are all listed in Table 2-16. However, 14% (eight) of the subgroups incorporate 51% of the standards in this group. These are shown in Table 2-15 below.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
505	General Piping Requirements	121	16.8%
516	Refrigeration Systems	51	7.1
583	Boats, Boat Handling and Stowage	48	6.7
573	Cargo Handling Systems	43	6.0
512	Ventilation Systems	35	4.9
540	Fuels and Lubricants, Handling and Storage	27	3.8
517	Auxiliary Boilers and Other Heat Sources	22	3.1
500	Auxiliary Systems, General	21	2.9
	TOTAL	368	51.2%

TABLE 2-15: THE EIGHT SUBGROUPS WHICH INCORPORATE THE LARGEST NUMBER OF STANDARDS IN SWBS 500-599, AUXILIARY SYSTEMS.

General Piping Requirements (SWBS 505) has 121 standards. There are 33 ANSI standards which deal with pipe fittings (mostly dimensions) plus 27 ASTM standards dealing with pipe and fittings (mostly composition). The 26 MARAD standards deal principally with requirements for piping systems and with specifications for fittings and hangers. The 18 Coast Guard standards apply to design requirements, definitions and testing.

Refrigeration Systems (SWBS 516) has 51 standards. MARAD accounts for 39, regulations on ships service and cargo refrigeration. ABS, ANSI, SNAME, USCG, and USDA supplied the remaining 12 standards.

Boats, Boat Handling and Stowage (SWBS 583) with 48 standards is dominated by 38 Coast Guard requirements for lifeboats, their components, and equipment, such as bilge pumps. Coast Guard life jacket requirements are also found in this section.

Cargo Handling Systems (SWBS 573) with 43 standards represents 6% of the Auxiliary Systems Group. The ABS rules covering cargo tanks and their certification are half of the entries. MARAD standards for rigging, lines, slings, cargo winches, vang winches plus the Coast Guard requirements vis-a-vis tanks and venting are the other half.

Ventilation Systems (SWBS 512) is made up of ABS and MARAD standards. The ABS standards cover rules for ventilation, while the MARAD standards concentrate on parts, such as registers and louvers.

Fuels and Lubricants, Handling and Storage (SWBS 540) has 27 standards for 3.8% of the group total. Twenty-four of these are MARAD standards dealing with parts of the fuel system, such as controls, heaters, and sludge tanks.

Auxiliary Boilers and Other Heat Sources (SWBS 517) with 22 standards (3.1% of the group) has 17 Coast Guard standards applying to auxiliary boiler safety. There are 3 UL standards and 2 MARAD standards.

The general category, Auxiliary Systems, General (SWBS 500) has 21 standards or 2.9% of the standards in the group. These standards by ABS, ANSI, IEEE, JIC, MARAD, TEMA, and the Coast Gua

generally apply to piping or electrical systems which could be used on any of several auxiliary systems. For example, the TEMA standard gives the physical properties of various fluids which are processed through tubular heat exchangers. Thus it has been classified in this category rather than in association with any system.

Table 2-16 on pages 26 and 27 includes a listing of all the subgroups to which standards were assigned.

The Outfitting and Furnishings (600-699) is next to the largest with half as many standards (383) as SWBS 500-599, Auxiliary Systems, or 15% of the total.

SWBS 665, Work Shops, Labs, Test Areas (including Portable Tools and Equipment) was the largest subgroup, with 24% of the standards. It is dominated by FED Specs on tools (mallets and mauls, wood, etc.), including asbestos mittens, and MARAD Specs on work shops.

SWBS 640, Living Spaces, with 77 standards, includes many MARAD standard furniture pieces, including the proverbial scuttlebutt.

SWBS 651, Commissary Spaces, has 35 standards including FED Specs for cooking tools, such as sifter, flour, pots and pans aluminum alloy. It also includes the MARAD standards for commissary equipment, such as tilting bins. There are, in addition, 6 UL standards on electrical appliances.

SWBS 631, Painting, with 30 standards, includes FED Specs, MIL Specs, and MARAD Specs for paints and painting. The Swedish standards are in this subgroup, issued as Structural Steel Painting Council Standard VIS-1-671, Pictorial Surface Preparation Standards for Painting Steel Structurals.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
500	Auxiliary Systems, General	21	2.9
503	Pumps	2	0.3
504	Instruments & Instrument Boards	11	1.5
505	General Piping Requirements	121	16.8
506	Overflows, Air Escapes & Sounding Tubes	8	1.1
507	Machinery and Piping Designation and Marking	4	0.6
508	Thermal Insulation for Piping and Machinery	10	1.4
509	Thermal Insulation for Vent and Air Conditioning Ducts	6	0.8
510	Climate Control	19	2.6
511	Compartment Heating System	10	1.4
512	Ventilation System	35	4.9
513	Machinery Space Ventilation System	9	1.3
514	Air Conditioning System	11	1.5
516	Refrigeration System	51	7.1
517	Auxiliary Boilers & Other Heat Sources	22	3.1
520	Sea Water System	8	1.1
522	Sprinkler System	10	1.4
524	Auxiliary Sea Water System	1	0.1
526	Scuppers and Deck Drains	7	1.0
528	Plumbing Drainage	6	0.8
529	Drainage and Ballasting System	9	1.3
530	Fresh Water System	9	1.3
531	Distilling Plant	5	0.7
532	Cooling Water	2	0.3
533	Potable Water	4	0.6
534	Aux. Steam & Drains Within Machinery Box	7	1.0
536	Aux. Fresh Water Cooling	1	0.1
540	Fuels and Lubricants, Handling and Storage	27	3.8
541	Ship Fuel and Fuel Compensating Sys.	7	1.0
	SUBTOTAL	443	61.6%

TABLE 2-16: DISTRIBUTION OF STANDARDS IN SWBS GROUP 500-599, AUXILIARY SYSTEMS. (Continued on next page)

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
542	Aviation and General Purpose Fuels	1	0.1
543	Aviation and General Purpose Lube Oil	2	0.3
544	Liquid Cargo	16	2.2
545	Tank Heating	4	0.6
549	Special Fuel and Lube Handling and Stowage	1	0.1
550	Air, Gas & Misc. Fluid Systems	10	1.4
551	Compressed Air Systems	13	1.8
552	Compressed Gases	4	0.6
555	Fire Extinguishing	14	1.9
556	Hydraulic Fluid System	7	1.0
557	Liquid Gases	4	0.6
558	Special Piping Systems	13	1.8
561	Steering and Diving Control Systems	16	2.2
562	Rudder	6	0.8
565	Trim and Heel Sys. (Surface Ships)	1	0.1
568	Maneuvering Systems	2	0.3
570	Underway Replenishment Systems	1	0.1
572	Ship Stores and Equip. Handling Sys.	2	0.3
573	Cargo Handling Systems	43	6.0
580	Mechanical Handling Systems	5	0.7
581	Anchor Handling and Stowage Systems	18	2.5
582	Mooring and Towing Systems	15	2.1
583	Boats, Boat Handling & Stowage	48	6.7
584	Mechanically Operated Door, Gate, Ramp, Turntable System	3	0.4
589	Misc. Mechanical Handling Systems	8	1.1
593	Environmental Pollution Control Systems	17	2.4
599	Aux. Systems Repair Parts and Tools	2	0.3
	TOTAL	719	100.0%

TABLE 2-16: DISTRIBUTION OF STANDARDS IN SWBS GROUP 500-599, AUXILIARY SYSTEMS

The remainder of Group 600-699 is very diverse, reflecting the broad spread of outfit work on any ship. Table 2-17 on page 29 lists all the subgroups. It is suggested that this group be given close screening by the cognizant F-25 Subcommittees 01, 02, 03, 04, 07, 10, 11, and 13, with most of the work falling on 03.

The Armament Group (700-799) has only 11 standards, all USCG, and all dealing with either signal flares or line throwing guns as indicated in Table 2-18.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
761	Small Arms and Pyrotechnic Launching Devices	3	27.0
763	Small Arms and Pyrotechnic Stowage	8	73.0
	TOTAL	11	100.0

TABLE 2-18: DISTRIBUTION OF STANDARDS IN SWBS GROUP 700-799, ARMAMENT.

The Integration and Engineering Group (800-899) has 19 standards, shown in Table 2-19, which deal primarily with ABS guidance for engineering calculations.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
835	Engineering Calculations	17	89.5%
842	Trials	1	5.3
853	Supply Support	1	5.3
	TOTAL	19	100.0%

TABLE 2-19: DISTRIBUTION OF STANDARDS IN SWBS GROUP 800-899, INTEGRATION AND ENGINEERING.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
600	Outfit and Furnishings, General	3	0.8
602	Hull Designating and Marking	16	4.2
603	Draft Marks	3	0.8
604	Locks, Keys and Tags	2	0.5
605	Rodent and Vermin Proofing	1	0.3
611	Hull Fittings	7	1.8
612	Rails, Stanchions and Lifelines	4	1.0
613	Rigging and Canvas	5	1.3
620	Hull Compartmentation	2	0.5
622	Floor Plates and Gratings	4	1.0
623	Ladders	9	2.3
624	Non-Structural Closures	5	1.3
625	Airports, Fixed Portlights and Windows	6	1.6
630	Preservatives and Coverings	7	1.8
631	Painting	30	7.8
632	Zinc Coating	1	0.3
633	Cathodic Protection	7	1.8
634	Deck Covering	12	3.1
635	Hull Insulation	11	2.9
637	Sheathing	3	0.8
638	Refrigerated Spaces	2	0.5
640	Living Spaces	77	20.1
644	Sanitary Spaces and Fixtures	13	3.4
650	Service Spaces	1	0.3
651	Commissary Spaces	35	9.1
652	Medical Spaces	4	1.0
654	Utility Spaces	2	0.5
660	Working Spaces	2	0.5
661	Offices	7	1.8
664	Damage Control Stations	3	0.8
665	Workshops, Labs, Test Areas (incl. Portable Tools & Equip.)	92	24.0
672	Storerooms and Issue Rooms	3	0.8
673	Cargo Stowage	3	0.8
699	Outfit & Furn. Repair Parts & Special Tools	1	0.3
	TOTAL	383	100.0

TABLE 2-17: DISTRIBUTION OF STANDARDS IN SWBS GROUP 600-699, OUTFIT AND FURNISHINGS

The Ship Assembly and Support Services Group (900-999) has 9 standards in it. Two were issued by the Department of Labor and cover ship ship building and ship repairing safety. One is an ABS Test Standard, and two are MARAD Test Specifications. One is a MARAD Specification on delivery. The remaining three are from the Manufacturers Standardization Society of the Valve and Fittings Industry and apply to inspection of valves.

SWBS SUBGROUP NUMBER	SWBS TITLE	NUMBER OF STANDARDS	PERCENT OF SUBGROUP
900	Ship Assembly and Support Services	2	22.2%
983	Delivery	1	11.1
986	Test and Inspection	5	55.5
990	Construction Support	1	11.1
	TOTAL	9	100%

TABLE 2-20: DISTRIBUTION OF STANDARDS IN SWBS GROUP 900-999, SHIP ASSEMBLY AND SUPPORT SERVICES.

There are 6 standards classified as "other". These all deal with stores or cargo.

2.2.2 Multiple Sources

Thirty-eight SWBS subgroups contain standards which have been written by more than one standards organization; for example, SWBS 042 has five Coast Guard and three ANSI standards. SWBS includes standards written by ten different organizations. Table 2-21 on the next page shows how many standards were incorporated into each of these SWBS categories by more than one standards writing organization.

Problems may arise because neither the content nor the purpose of the multiple standards was coordinated. The F-25 Committee on Shipbuilding had not been founded at the time these standards were written, and no organization had assumed a standards coordinating role.

SOURCE ↓ / SWBS →	042	070	086	200	235	242	300	302	303	304	305	311	312	313	314	320	321	324	330	331	332	400	422	423	424	426	430	432	436	437	441	443	500	517	561	633	651	655
ABS		2	1		5	1	12	3	6	7		3	2	2		7	2	1		4	1		1	1		2	2		1	1	1					2		1
FED																																						1
MARAD				2			10	6	2	6	2	2	2	2	2	4		12	6	2	8	2	3	4	2	4	6		2	2	6	4		·	2	2	2	4
MIL										4																												
USCG	5				1		12	4	1	4		2	12	3	1			2		2			2				3	1	5			1		2	2			
USN										1																												
ANSI	3						2	1			1														1							2						
ASTM		1					1			5																												
IEEE		1			9	2	23												1						4		2	1	2				2				
IES																			1																		
IPCEA										1																												
JIC			1					2	6	5																								2				
NEMA				1			7	1	7	4		1		1	1		2	4				1					4			1								
NFPA		1					1							2																								
UL							11	3	11	3						1	1	1	1		2													3			1	

TABLE 2-21: NUMBER OF STANDARDS WHICH HAVE BEEN WRITTEN BY MORE THAN ONE ORGANIZATION FOR THE SAME SWBS SUBGROUP.

2.3 ANALYSIS BY ASTM F-25 SUBCOMMITTEE

2.3.1 General Observations

There is no direct correspondence between SWBS numbers and the F-25 subcommittee structure. The SWBS numbers are organized by ship system. The subcommittees have names which resemble system names, but in fact the charters of the subcommittees are oriented towards parts or processes. The F-25.01 Subcommittee deals with material, regardless of whether that material is in the hull, or machinery or outfit groups of the ship. The Welding Subcommittee obviously deals with processes, not a system. The Electrical Subcommittee deals with electrical items whether they fall into SWBS 200 (Propulsion Plant), 300 (Electrical Plant), 400 (Command and Surveillance), or 500 (Auxiliary Systems).

Table 2-22 on page 33 shows the relationship of SWBS groupings to F-25 subcommittee assignment. The number of standards is shown for each SWBS subgroup and each subcommittee. Table 2-23 below shows the percent of the 2596 standards associated with each subcommittee.

F-25 SUBCOMMITTEE		% OF STANDARDS
01	MATERIAL	4
02	COATINGS	3
03	OUTFITTING	21
04	HULL STRUCTURE	10
05	H.V.A.C.	6
06	SHIP CONTROL AND AUTOMATION	1
07	GENERAL SUPPORT REQUIREMENTS	6
08	DECK MACHINERY	1
10	ELECTRICAL	21
11	MACHINERY	11
12	WELDING	1
13	PIPE SYSTEMS	15
93	TERMINOLOGY	0
		100%

TABLE 2-23: PERCENTAGE OF STANDARDS ASSIGNED TO EACH F-25 SUBCOMMITTEE.

F-25 SUBCOMMITTEE / SWBS CLASSIFICATION	000 GEN. GUIDANCE	100 HULL STRUCTURE	200 PROP. PLANT	300 ELECT. PLANT	400 COMMAND & SURVEILANCE	500 AUX. SYSTEM	600 OUTFIT FURNISHINGS	700 ARMAMENT	800 INTEGRATION & ENGINEERING	900 SHIP ASSEMBLY & SUPPORT SERVICE	OTHER	TOTAL
1 MATERIALS	84	5	11	0	0	4	2	0	2	0	1	109
2 COATINGS	1	1	6	0	0	7	50	0	0	0	0	65
3 OUTFITTING	19	31	4	0	19	170	293	11	2	0	3	551
4 HULL STRUCTURE	13	223	2	0	0	14	1	0	2	0	0	255
5 HVAC	2	0	0	0	2	141	5	0	0	0	0	150
6 SHIP CONTROL & AUTOMATION	3	0	20	0	4	6	0	0	0	0	0	33
7 GENERAL REQUIREMENTS	115	17	2	0	0	6	7	0	13	2	0	162
8 DECK MACHINERY	1	1	0	2	0	14	0	0	0	0	0	18
10 ELECTRICAL/ELECTRONICS	24	0	27	341	97	21	18	0	5	0	0	533
11 MACHINERY	34	0	200	6	0	42	1	0	2	0	1	286
12 WELDING	29	0	6	0	0	0	0	0	0	0	0	35
13 PIPING	14	1	69	0	1	293	6	0	1	0	1	386
90 EXECUTIVE	0	0	0	0	0	0	0	0	0	0	0	0
91 LONG-RANGE PLANNING	0	0	0	0	0	0	0	0	0	0	0	0
92 EDITORIAL	0	0	0	0	0	0	0	0	0	0	0	0
93 TERMINOLOGY	4	5	1	1	0	1	0	0	0	0	0	12
TOTAL	343	284	348	350	123	719	383	11	27	2	6	2596

TABLE 2-22: DISTRIBUTION OF STANDARDS AS CLASSIFIED IN THE SHIP WORK BREAKDOWN STRUCTURE (SWBS)

Two conditions exist which will need to be considered by the Executive Subcommittee in directing the work of the subcommittees. Now that F-25 has accepted an active role in the coordination of the shipbuilding standards program, the Executive Subcommittee will need to resolve the following two conflicts:

First, a component of a ship or a facet of the shipbuilding process falls into the scope of more than one subcommittee. The need for liaison between subcommittees is already recognized. However, knowing when or where the liaison is needed is harder to determine. The SWBS numbers are a guide. Anytime a SWBS number is assigned to more than one subcommittee a need for liaison possibly exists. The same consideration should be given to providing liaison when a "hole" is identified in standards coverage.

Second, there is the potential conflict of more than one organization writing standards for the same or closely related subjects. At present, the best way we have of identifying this problem is to identify all SWBS numbers for which standards have been written by more than one organization. There are two levels at which this should be done. One analysis should be made for all SWBS categories without taking into account the subcommittee assignments, and another analysis should be made in which all the SWBS numbered standards assigned to a subcommittee are examined to see if any SWBS subgroups have been covered by more than one organization.

One example of the problem can be illustrated with Table 2-24 which shows the number of standards, by system, covered in the MARAD Standard Specifications for Steam and Diesel Vessels. Fourteen subjects or systems are included in the 153 standards identified with nine ASTM F-25 subcommittees.

SYSTEM	STEAM	DIESEL	TOTAL
HULL	5	5	10
FUEL	10	10	20
LUBE	7	7	14
SEAWATER	9	6	15
FUEL WATER	5	5	10
FEED & CONDENSATE	10	5	15
STEAM & EXHAUST	10	4	14
LIQUID CARGO	5	5	10
POLLUTION ABATEMENT	4	2	6
TANK LEVEL	3	7	10
COMPRESSED AIR	3	3	6
MACHINERY PIPING	8	8	16
INSULATION	3	3	6
OTHER	1	0	1
TOTALS	83	70	153

TABLE 2-24: NUMBER OF STANDARDS FOR EACH SUBJECT COVERED BY THE MARAD STEAM AND DIESEL SPECIFICATION. THESE STANDARDS ARE DIVIDED AMONG NINE SUBCOMMITTEES.

In working with the computer runs, it became obvious that the number of standards in this subtask was too large for efficient or accurate analysis by manual methods. There are too many entries. The Executive Committee may want to obtain ADP sorts which present the data needed to manage the two conflicts just described. A print-out sorted by subcommittee, then by SWBS, then by originating organization would help with the problem of duplication within the subcommittee's jurisdiction. Another sort, this one by SWBS and then by subcommittee and then by originating organization, would also be useful.

2.3.2 Detailed Examination of SWBS Assignments to Each F-25 Subcommittee

01 MATERIAL

The Materials Subcommittee was tentatively assigned standards written by eight organizations as shown in Table 2-25.

SOURCE	NUMBER OF REFERENCES	PERCENT
ABS	28	26
FED	7	6
MIL	2	2
MSS	3	3
USCG	9	8
REGULATORY SUBTOTAL	49	49
ANSI	14	13
ASTM	45	41
SNAME	1	1
INDUSTRIAL SUBTOTAL	59	51
TOTAL	109	100

TABLE 2-25: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE MATERIALS SUBCOMMITTEE.

The ABS standards apply to ferrous and non-ferrous materials for low temperature service, pressure vessels, machinery, hull plating and tanks. The ANSI standards are predominantly for fasteners. The ASTM standards deal with composition and testing of various steel and aluminum alloys used in plates, forging and castings. Six plastic standards issued by ASTM and ANSI are within the cognizance of this committee. The USCG standards deal with buoyancy materials and the testing of pressure vessels.

02 COATINGS

The 65 standards tentatively assigned to the Coatings Subcommittee were originated by nine organizations, as shown in Table 2-26.

SOURCE	NUMBER	PERCENT
ABS	2	3
DOD	2	3
FED	17	26
MARAD	23	35
MIL	18	28
USCG	1	2
	97	63
ASTM	1	2
SSPC	1	2
	65	100

TABLE 2-26: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE COATINGS SUBCOMMITTEE.

The coatings covered by the standards include insulation materials, paints and deck coverings. The Swedish Pictorial Surface Preparation Standards are assigned to this subcommittee.

03 OUTFITTING

Table 2-27 on the following page shows the distribution of standards by source. The most striking number from the table is that 97% of the standards under the Outfitting Subcommittee are from regulatory sources, predominantly MARAD, FED Specs, ABS and USCG.

Eighty percent of the standards divide in the manner shown in Table 2-28 on page 39.

SOURCE	NUMBER	PERCENT
ABS	100	18
DOL	1	0
FED	104	19
MARAD	235	43
MIL	23	4
PCC	3	1
SCA	1	0
USCG	68	12
SUBTOTAL	535	97
ANSI	4	1
ASTM	1	0
IEEE	3	1
NEMA	1	0
NFPA	1	0
SNAME	1	0
UL	5	1
SUBTOTAL	16	3%
TOTAL	551	100%

TABLE 2-27: DISTRIBUTION BY ORIGINATING ORGANIZATION OF THE STANDARDS UNDER THE COGNIZANCE OF THE OUTFITTING SUBCOMMITTEE.

It is to be noted that hotel items are dominant, accounting for 28% of the total and 37% of the MARAD items and 32% of the FED Spec items.

Workshops and tools are the second most popular category with 74 standards, or 17% of the 439 total. Once again both MARAD and FED Specs cover the same subjects heavily.

Because the same material is covered by standards from several sources, and because the two basic subjects inherently

	NUMBER OF STANDARDS				PERCENTAGE			
	MARAD	FED	ABS	TOTAL	MARAD	FED	ABS	TOTA
HOTEL ITEMS, INCLUDING: FURNITURE, COMMISSARY, PLUMBING, JOINER ITEMS	88	33	---	121	37	22	---	28
HULL MACHINERY, DECK MACHINERY, MOORING	38	---	2	40	16	---	2	9
LABELS, MARKING, NOTICES	18	1	3	22	8	1	3	5
WORK SHOPS, TOOLS	11	63	---	74	5	61	---	17
CARGO GEAR, RIGGING	11	---	10	21	5	---	10	5
LADDERS, GRATING, WALKWAYS	10	1	---	11	4	1	---	3
GROUND TACKLE	8	---	4	12	3	---	4	3
OPENINGS, CLOSURES, PORTHOLES, DOORS, HATCHES	8	---	8	16	3	---	8	4
INSULATION	5	---	---	5	2	---	---	1
FIRE PROTECTION, DETECTION	5	---	9	14	2	---	9	3
LIFE SAVING EQUIPMENT	5	---	1	6	---	---	1	1
CARGO CONTAINMENT, TANKS	---	---	31	31	---	---	31	7
STRUCTURAL DESIGN	---	---	8	8	---	---	8	2
STEERING GEAR	---	---	2	2	---	---	2	1
OTHER	28	6	22	56	12	6	22	1
TOTAL	235	104	100	431	100	100	100	10

Table 2-28: COMPARISON OF NUMBER OF STANDARDS BY SUBJECT UNDER COGNIZANCE OF THE OUTFITTING SUBCOMMITTEE.

offer opportunities for cost savings in these areas, the Outfit Subcommittee would do well to compare the documents to identify conflicts, overlaps, and voids. The standards in this group may be candidates for replacement by more cost effective alternatives.

04 HULL STRUCTURE

The preponderance (88%) of the standards for hull structure are issued by ABS. However another 11% are from the MARAD Standard Specification and also cover hull structure. In addition, the MarAd standards address the chain locker, which is also covered by ABS. See Table 2-29.

SOURCE	NUMBER	PERCENT
ABS	220	86
MARAD	29	11
USN	1	0
SUBTOTAL	250	98
ASTM	4	2
SNAME	1	0
SUBTOTAL	5	2
TOTAL	255	100%

TABLE 2-29: DISTRIBUTION BY ORIGINATING ORGANIZATION OF THE STANDARDS UNDER THE COGNIZANCE OF THE HULL STRUCTURE SUBCOMMITTEE.

05 HVAC

There are 150 standards tentatively assigned to the Heating, Ventilating, and Air-conditioning Subcommittee. Ninety-one percent are from the regulatory group and nine percent from the industrial group. Seventy percent are MARAD standards. The majority of these describe equipment, about one-quarter describe systems, and a few cover insulation.

The ABS standards similarly cover equipment and systems, but with greater emphasis on system requirements.

Table 2-30 shows the distribution of standards as tentatively assigned to F-25.05.

SOURCE	NUMBER	PERCENT
ABS	11	8
FED	3	2
MARAD	105	70
MIL	1	1
NBS	1	1
USCG	12	8
USDA	3	2
SUBTOTAL	136	91
AMCA	2	1
ANSI	4	3
IEEE	3	2
SNAME	1	1
UL	4	3
SUBTOTAL	14	8
TOTAL	150	100%

TABLE 2-30: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE HVAC SUBCOMMITTEE.

06 SHIP CONTROL AND AUTOMATION

Once again MarAd provided the largest portion (38%) of these standards; ABS and IEEE are second with 24% each. This subcommittee will be very busy because good performance and design standards for control and automation appear to be needed at this time by the maritime industry.

Table 2-31 lists the standards by organization.

SOURCE	NUMBER	PERCENT
ABS	8	24
MARAD	13	38
SUBTOTAL	21	64
ANSI	4	12
IEEE	8	24
SUBTOTAL	12	36
TOTAL	33	100%

TABLE 2-31: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE SHIP CONTROL AND AUTOMATION SUBCOMMITTEE.

07 GENERAL SUPPORT REQUIREMENTS

A surprising 6% of the standards was tentatively assigned to this subcommittee. ABS accounted for two-thirds of them. Most of the ABS references dealt with design requirements or engineering rules. There were also 30 MARAD standards directed mostly at design and engineering functions. The subcommittee may want to make an item by item comparison of the requirements of these two organizations. ANSI drawing standards are also assigned to this subcommittee.

Table 2-32 on the next page lists the standards organization and the number of standards that they have contributed to this subcommittee.

08 DECK MACHINERY

Two-thirds of these standards come from ABS and USCG. One-third comes from industrial sources shown in Table 2-33. The ABS rules apply to jacking systems for offshore rigs, mooring equipment, steering gear, elevators and hoists. The Coast Guard covers elevators plus life boat apparatus.

SOURCE	NUMBER	PERCENT
ABS	108	67
DOL	3	2
EPA	1	1
IMCO	1	1
MARAD	30	18
MIL	2	1
USCG	1	1
USPH	1	1
SUBTOTAL	147	90
ANSI	10	6
HEI	1	1
IEEE	3	2
SNAME	1	1
SUBTOTAL	15	10
TOTAL	162	100%

TABLE 2-32: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE GENERAL SUPPORT REQUIREMENTS SUBCOMMITTEE.

SOURCE	NUMBER	PERCENT
ABS	6	35
USCG	5	29
SUBTOTAL	11	64
ANSI	2	12
IEEE	2	12
SNAME	1	6
UL	1	6
SUBTOTAL	6	36
TOTAL	17	100%

TABLE 2-33: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE DECK MACHINERY SUBCOMMITTEE.

Standards from IEEE for motors and controllers, ANSI standards for elevator safety, and an SNAME guide to the design and testing of anchor windlasses written in 1964 are from the industrial standards organizations.

10 ELECTRICAL AND ELECTRONICS

The proportion of regulatory to industrial standards is 55% to 45% as can be seen in Table 2-34. About 50% of the SWBS numbers which are listed on the computer run as being under the cognizance of the electrical subcommittee have standards written by two or more organizations. For example, SWBS 304, Electric Cables, includes standards written by ten organizations; ABS, MARAD, MIL Spec, USCG, USN, ASTM, IPCEA, JIC, NCMA, and UL. The probability that these standards cover the subject and do not overlap or conflict is remote. Table 2-35 on the following page shows how many standards were issued by each originating organization for each SWBS category assigned to the electrical subcommittee. If all the standards for the SWBS category were written by one standards group no entry is shown in the table.

SOURCE	NUMBER	PERCENT
ABS	72	13
FED	1	0
MARAD	141	26
MIL	5	1
USCG	72	13
USN	1	0
SUBTOTAL	292	55
ANSI	12	2
ASTM	7	1
IEEE	100	19
IES	1	0
IPCEA	1	0
JIS	43	8
NEMA	33	6
NFPA	2	0
UL	43	8
SUBTOTAL	242	45
TOTAL	534	100%

TABLE 2-34: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UN. THE COGNIZANCE OF THE ELECTR AND ELECTRONICS SUBCOMMITTEE

11 MACHINERY

The Machinery Subcommittee has tentative cognizance for 286 standards which have been written by 12 different organizations, five regulatory plus seven industrial.

	ABS	FED	MARAD	MIL	USCG	USN	ANSI	ASTM	IEEE	IES	IPCEA	JIC	NEMA	NFPA	UL
042					5		3					1	1		
070	1							1	1					1	
095	1								2						
235	5			1					9						
242	1								2						
300	12		10		12			2	17			21	7		11
302	2		5		4		1		17			2	1		3
303	6		2		1				5			5	7		11
304	7		6	4	4	1		5	7		1	6	2		5
305			2				1								
311	3		2		2				2				1		
312	1		2		12				1						
313	3		2		3				1				1		1
314	1		2		1		1		6				2		
320	7		4						2						1
321	1												2		1
324	2		12		3				3				4		1
330			6							1					1
331	3		2		3										
332	1		8						1						2
400			2										1		
422	1		3		1				2						
423			4						2						
424			2				1								
426			4						2						
430	2		6		3				2				4		
432	1				1				1						
436	1		2		5				2						
437	1		2						1				1		
441			6				2		1						
443			4		1										
500									2			2			
517					2							3			
561			2		2										1
633	2														
665	1	1	4												

TABLE 2-35: NUMBER OF STANDARDS BY ORIGINATING ORGANIZATION FOR SWBS WITH MORE THAN ONE ORIGINATING ORGANIZATION (Subcommittee F-25.10 only).

MarAd is the largest single contributor; mainly from sections 50 to 55, 61, 62, 70, 72, 73, 76, 77, 78, 85, 86, and 102 of the MarAd Standard Specification for Steam Vessels. Eighty-seven standards are from that source. In addition, 88 standards are classified from sections 50 through 63, 72, 73, 76, 78, 80, and 85 of the MarAd Specification for Diesel Vessels.

Table 2-36 shows the distribution of sources of the other standards.

SOURCE	NUMBER	PERCENT
ABS	31	11
FED	1	0
MARAD	175	61
MIL	4	1
USCG	37	13
SUBTOTAL	248	87
ABYCP	1	0
ANSI	14	4
ASTM	10	3
HEI	6	2
IEEE	3	1
SNAME	3	1
TEMA	1	0
SUBTOTAL	38	11
TOTAL	286	100%

TABLE 2-36: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE MACHINERY SUBCOMMITTEE.

12 WELDING

The Welding Subcommittee's standards cover welding requirements for boilers, piping, unfired pressure vessels, hull machinery

and cargo tanks, on both steel and aluminum vessels; drilling units, barges, dry docks, and single point moorings. They cover electrodes, processes, fluxes, cladding materials, heat treatment, brazing and materials. The testing of welds, qualification of welders and required documentation are included.

ABS and the Coast Guard cover similar subjects, offering an opportunity for the subcommittee to standardize the tests and documentation for qualification of welds, welders, and materials so that the same test and paper work will meet both ABS and Coast Guard requirements. There are also requirements for radiographic examination of pressure vessels and piping in some ABS standards under the cognizance of the Piping System Subcommittee.

Table 2-37 shows distribution of standards by originating organization.

SOURCE	NUMBER	PERCENT
ABS	19	53
MARAD	1	3
USCS	16	44
TOTAL	36	100%

TABLE 2-37: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE WELDING SUBCOMMITTEE.

13 PIPING SYSTEMS

Table 2-38 on the next page shows the sources of the standards tentatively assigned to this subcommittee. The five largest sources are MARAD at 41%, ABS at 16%, ANSI at 15%, and USCG and ASTM at 12% each.

ABS rules and USCG regulations cover many of the subjects, although in different languages. In addition, ABS and USCG standards include firefighting. It is not known at this time if conflicts or overlaps exist or if voids need to be filled.

SOURCE	NUMBER	PERCENT
ABS	61	16
EPA	3	10
FED	2	1
MARAD	153	41
MIL	4	1
USCG	45	12
SUBTOTAL	268	72
ANSI	57	15
ASTM	33	12
FCI	1	0
MSS	12	3
OCIMF	2	1
SUBTOTAL	105	28
TOTAL	373	100%

TABLE 2-38: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE PIPING SYSTEMS SUBCOMMITTEE.

93 TERMINOLOGY

Twelve standards are referred to this subcommittee. The sources are:

	NO.	%
ABS	7	59
MIL	1	8
SUBTOTAL	8	67
ANSI	2	17
HEI	1	8
IEEE	1	8
SUBTOTAL	4	33
TOTAL	12	100%

TABLE 2-39: DISTRIBUTION BY ORIGINATING ORGANIZATION OF STANDARDS UNDER THE COGNIZANCE OF THE TERMINOLOGY SUBCOMMITTEE.

The ABS standards deal with the definition of barges, bulk carriers, floating dry docks, and aluminum vessels. The MIL Spec is STD-12C, which lists abbreviations for use on drawings and in specifications, standards, and technical documents.

The four commercial standards are definitions or terminology for fasteners, acoustical shock, steam condensers and electrical items.

3.1 SUMMARY OBSERVATIONS

An integrated family of shipbuilding standards is needed in the United States.

An integrated family of standards should:

- Be sensitive to costs and risks
- Protect the interests of all affected parties
- Avoid holes in the required coverage by standards
- Prevent conflicts between standards
- Provide for cyclical review
- Be timely
- Be coherent
- Be codified

At the moment several problems exist with the present system of standards which prevent the standards from being as helpful to shipbuilders as they should be. A good set of shipbuilding standards should minimize the technical and financial risk to which the shipbuilding industry is exposed. Standards should aid the owner, the designer, the builder, the vendor and the regulatory and classification bodies.

In the absence of initiative by the maritime industry, the regulator-classification community has developed the standards

used in United States shipyards and consequently the standards tend to be self-serving. An integrated family of shipbuilding standards must protect the interests of all concerned parties. These concerned parties are just beginning to commit themselves to the development of an integrated system of standards.

One of the problems faced by the shipbuilding industry is the sheer number of standards. Japanese and Northern European shipbuilders concur that the required number of standards for shipbuilding lies somewhere between 500 and 1,000. Possibly the need the United States is for a higher number, but it is unlikely that the industry requires five to ten times as many standards.

To complicate this problem, these numerous standards have been written by at least 35 unrelated groups with different and even divergent objectives. The standards in use today have been written over a long time span - some go back over 20 years. A coordinating agency did not exist. Consequently the standards lack coherence. Not all desired subjects are covered by standards. Some overlap in standards is evident, and there are some areas for which as many as ten different standards exist. This plagues the shipbuilder and the industries which support him. The very existence of certain standards supports costly requirements in excess of the needs of safety and reliability.

The alleviation of these problems can come about when the maritime industry participates in a systematic approach to standards writing. The naval architects and marine engineers can make a significant contribution to shipbuilding risk and cost reduction by participation in the standards program. One of the major reasons foreign shipbuilders are able to build ships for less manhours than U.S. yards is the strong standards program which exists overseas. A MarAd sponsored study team from National Steel and Shipbuilding Company, Ingalls Shipbuilding Division of

Litton industries and Bath Iron Works found that the Managing Directors of the major northern European shipyards were so completely convinced that standards were a necessary tool for cost reduction that each yard maintained a group of standards engineers to assist management. Time and time again the U.S. study team was told that the Managing Directors were so certain that standards reduced both cost and risk that they did not require their standards groups to document the amount of the savings.

The present effort under MarAd guidance to coordinate standards through ASTM Committee F-25 on Shipbuilding offers an opportunity for the maritime interests in the United States to apply their very considerable talents to a long neglected avenue to financial benefit for all.

APPENDIX A

LIST OF ORGANIZATIONS
ALPHABETICAL BY ACRONYM

APPENDIX A
LIST OF ORGANIZATIONS
ALPHABETICAL BY ACRONYM

ABS	American Bureau of Shipping Rules for Building and Classing Steel Vessels
ABS 01	Nondestructive Inspection of Hull Welds
ABS 02	Approved Welding Electrodes Wire-Flux & Wire-Gas Combinations
ABS 03	Offshire Mobile Drilling Units
ABS 04	Steel Barges for Offshore Service
ABS 05	Bulk Carriers for Service on the Great Lakes
ABS 06	River Rules '71
ABS 07	Inert Gas Installations on Vessels Carrying Oil in Bulk
ABS 08	Certification of Cargo Containers
ABS 09	Manual for Making Bronze Propeller Repairs
ABS 10	Repair, Welding, Cladding and Straightening of Tail Shafts
ABS 11	Burning Crude Oil and Slops in Main and Auxiliary Boilers
ABS 12	Steel Floating Dry Docks
ABS 13	Underwater Inspection in Lieu of Dry Docking Survey
ABS 14	Construction of Shipboard Elevators
ABS 15	Certification of Construction and Survey of Cargo Gear on Merchant Vessels
ABS 16	Certification of Self-unloading Cargo Gear on Great Lakes Vessels
ABS 17	Single Point Moorings
ABS 18	Aluminum Vessels
ABS 19	Classification of Nuclear Ships
ABS 20	Submersible Vessels
ABYCP	American Boat and Yacht Council, Incorporated
AMCA	Air Moving and Conditioning Association, Incorporated
ANS	American National Standards Institute (SAME AS ANSI)
ANSI	American National Standards Insitiute
ASTM	American Society for Testing and Materials
DOD	Department of Defense
DOL	Department of Labor

EPA	Environmental Protection Agency
FCI	Fluid Controls Institute, Incorporated
FED	Federal Specification
HEI	Heat Exchange Institute
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IES	Illuminating Engineering Society
IMCO	Intergovernmental Maritime Consultive Organization
IPCEA	Insulated Power Cable Engineers Association
JIC	Joint Industrial Council
MARAD	Maritime Administration
MASS	MARAD Standard Specification
MASSD	MARAD Standard Specification - Diesel
MIL	Military Specification
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NBS	National Bureau of Standards
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OCIMF	Oil Companies International Marine Forum
PCC	Panama Canal Company
SCA	Suez Canal Authority
SNAME	Society of Naval Architects and Marine Engineers
SOLAS	Safety of Life at Sea, International Convention of
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturing Association
UL	Underwriters' Laboratories, Incorporated
USCG	Unites States Coast Guard
USDA	United States Department of Agriculture
USN	United States Navy
USPHS	United States Public Health Service